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# THE EFFECT OF DDT ON THE SWEETPOTATO WEEVIL

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The most satisfactory control for the sweetpotato weevil (*Cylas formicarius elegantulus* (Summers)) has been the use of sanitary measures. The adult is the only stage of this insect that may be readily affected by insecticides. Although arsenical and fluorine insecticides are toxic to adults, these materials have not proved satisfactory when applied in the fields; and no insecticides, except fumigants, have been effective in storage. In tests during 1944 and 1945 at Baton Rouge, La., with new insecticides against the sweetpotato weevil, DDT gave promising results. The results of these tests are reported for the information of others interested in the control of this insect.

## Methods

In the laboratory tests sprays and dusts were applied with small, bulb-type applicators to wire-screen cages (fig. 1) approximately 10 inches in diameter and 9 inches high. These cages, four to each treatment, were placed on soil benches either in the screened insectary or in the greenhouse. Ten adult weevils were then introduced into each cage and examined daily for 7 days, and the total mortality was recorded.

The field experiments were conducted in plots 4 rows wide and 50 feet long. The insecticides were applied with rotary hand dusters. There were six replicates in a latin-square arrangement in 1944 and five in randomized blocks in 1945.

The DDT in all formulations tested was the technical grade. The dust mixture, containing 10 percent of DDT, was prepared by the manufacturer by grinding technical DDT with pyrophyllite. When desired, further dilutions were made with pyrophyllite in the laboratory. The 10-percent DDT dust mixture was also used in the preparation of some of the baits and the spray suspensions. A proprietary emulsion of unknown composition was used in the laboratory tests; the concentrate contained 20 percent of DDT before dilution with water. Benzene and kerosene solutions were also prepared from undiluted technical DDT.

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A kerosene emulsion was used in the storage tests. A 5-percent DDT emulsion concentrate was prepared by dissolving 1 pound of technical DDT in 2½ gallons of kerosene, and adding about 2 ounces of a proprietary emulsifier consisting chiefly of a condensation product of ethylene oxide and an alkylated cresol. This concentrate was diluted with 20 to 50 gallons of water to make an emulsion containing from 0.24 to 0.55 percent of DDT and 5 to 11 percent of kerosene. The emulsions were applied to storage houses at a pressure of 250 pounds per square inch by means of a 100-gallon power sprayer equipped with an agitator and an adjustable nozzle.

## Laboratory Tests

In preliminary tests with the 10-percent DDT dust mixture, adult weevils were readily killed when put in cages heavily dusted with the insecticide. The weevils died regardless of the presence or absence of dusted food, and most of them were dead within 2 days. When this mixture was applied to sweetpotato roots and plants in cages before the introduction of 40 adult weevils, 39 and 33 adults, respectively, were killed in two tests, as compared with 40 and 39 adults in two tests with potassium fluosilicate and with 32 adults in one test with calcium arsenate.

There was little difference in the mortality of adults placed on potted sweetpotato plants after the application of dust mixtures containing 10, 5, and 2.5 percent of DDT and of water suspensions containing 1 and 0.5 percent of DDT. A suspension containing only 0.1 percent of DDT was less effective. A few tests were made with the proprietary DDT emulsion in strengths as low as 0.5 percent of DDT. The weevils were killed by the emulsion, but the potted plants were severely injured.

Five poisoned-bait tests were conducted, each consisting of 4 to 5 replications in which 10 adult weevils were used in each replication. The various baits consisted of 0.25 percent of DDT derived from 10-percent DDT dust mixture, 3.0 percent of technical DDT in dry form, and 1.4, 2.8, and 3.0 percent of DDT in benzene solution, all mixed with freshly ground sweetpotatoes. The mortalities produced by these baits, in the order listed, were 42.5, 62, 80, 87.5, and 74 percent. Baits prepared by mixing 1 part of paris green with 40 parts of ground sweetpotato, and tested as the standard for comparison of effectiveness, produced from 92.5 to 100 percent mortality. In these bait tests DDT was more effective in benezene solution than it was in dry form.

Nine cages were sprayed with different DDT preparations on June 22 so as to give thorough surface coverage without run-off, and tested over a period of more than 6 months to determine the length of time the DDT residues on the cages remained toxic to the adult weevils. Ten weevils were confined in each cage without food for a week, after which they were removed and the mortality was recorded. Fresh weevils were introduced each week until the weevils were no longer killed by the residues.

The nine spray preparations included 1, 3, and 5 percent of DDT in each of three formulations--kerosene solution, benezene solution, and the proprietary emulsion previously mentioned. The results as given in table 1 show that all sprays caused high mortality for several weeks. The duration of effectiveness increased with the percentage of DDT applied. At comparable strengths there was very little difference in effectiveness between the kerosene solution and the emulsion. The benzene solution at the 5-percent strength remained effective longer than the other sprays and was causing 90 percent mortality of the weevils after 23 weeks.

Similar tests were begun September 8 in cages 12 by 15 by 18 inches constructed of rough pine lumber, in order to simulate more closely conditions found in potato storages. One cage was sprayed once with the proprietary emulsion diluted to contain 3 percent of DDT, and another cage was dusted with the 10-percent DDT mixture. Each week 20 weevils were placed in each of these cages and in an untreated cage. All weevils put in the treated cages for 25 weeks after treatment were killed, and at the end of this time the cages were discontinued. Weevils in the check cage were normal during the observations, only an occasional specimen dying.

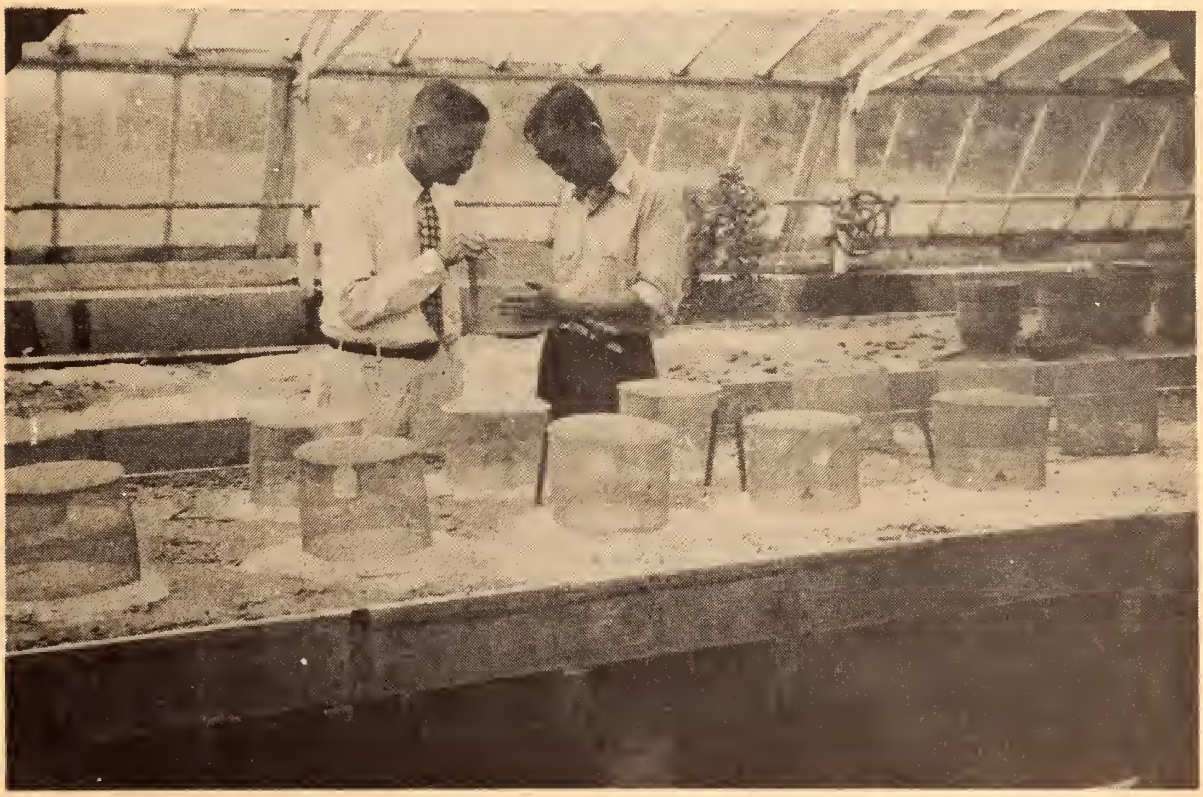

Fig. 1.-- Screen cages used in laboratory tests on the sweetpotato weevil.

Table 1. - Number of weevils killed in 7 days after being put in cages sprayed with different DDT insecticides on June 22, 1945. Ten weevils were put in each cage on indicated dates.

| Percent of DDT | June | | July | | | | August | | | | | September | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 | 29 | 6 | 13 | 20 | 26 | 3 | 10 | 17 | 24 | 31 | 7 | 18 | 25 |
| No Spray Applied | | | | | | | | | | | | | | |
| None | 7 | 2 | - | 3 | 6 | 0 | 1 | 7 | 1 | 2 | 0 | 0 | 0 | 1 |
| Kerosene-DDT Solution | | | | | | | | | | | | | | |
| 1 | 10 | 8 | 10 | 8 | 6 | 0 | 10 | 3 | 3 | 3 | 1 | 0 | - | - |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 8 | 7 | 7 | 0 | 1 | - | - |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 6 | 10 | 6 | 6 | 10 | 4 |
| Benzene-DDT-Solution | | | | | | | | | | | | | | |
| 1 | 10 | 10 | 10 | 10 | 9 | 8 | 10 | 6 | 5 | 9 | 0 | 1 | - | - |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 8 | 6 | 10 | 3 |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10[1] |
| A Proprietary DDT Emulsion | | | | | | | | | | | | | | |
| 1 | 10 | 10 | 10 | 9 | 4 | 4 | 8 | 5 | 4 | 4 | 1 | 0 | - | - |
| 3 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 1 | 7 | 8 | 0 |
| 5 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 8 | 10 | 4 |

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[1] Either 9 or 10 weevils were killed in each of the following 10 weeks.

## Field Tests

In 1944 five applications of 10-percent DDT dust were made to small plots of sweetpotatoes at the rate of 10 pounds of the dust per acre per application. The first application was made on June 6, one week after the plants were set in the field. The weevil infestation in the tubers at harvest was about the same as in the check plots. The vines prior to harvest appeared greener and more vigorous than those in the check plots, and there was no evidence of injury due to the insecticide. In another treatment 10 applications of calcium arsenate at 10 pounds per acre per application reduced the infestation 72 percent, but injured the foliage.

In 1945 a dust mixture containing 5 percent of DDT and 1 percent of petroleum oil in pyrophyllite was tested. The infestation was too low to warrant any conclusions regarding the effectiveness of this mixture, but the vines in dusted plots appeared more yellow and mature than those in undusted plots. It is possible that the oil was responsible for this injury. As much as 100 pounds of the mixture was applied per acre during the season.

## Tests in Storage Houses

During the summer of 1945 four storage houses near Sunset, La., were sprayed with DDT-kerosene emulsions prepared and applied as described under "Methods." House A, approximately 5,000 cubic feet in size, contained about 30 bushels of dry sweetpotatoes heavily infested with the sweetpotato weevil. On July 4, 20 gallons of a kerosene emulsion containing 0.6 pound of DDT was applied to the walls and floor and to the old potatoes and empty crates in the house. One-half bushel of the infested potatoes was placed in a large cage and sprayed, and for a check one-half bushel was placed in a cage and removed from the house before spraying. From 75 to 90 percent knock-down of weevils was observed in one-half hour. On July 9 a few "nervous," or agitated, adults were scattered over the house, and only a few active adults were on the potatoes; the remainder were dead. No live weevils were found in the treated cage during observations made at intervals from July 18 to September 8. The adults in the check cage appeared normal.

House B, approximately 700 cubic feet in size, was sprayed on July 19 with 8 gallons of kerosene emulsion containing 0.15 pound of DDT. After 9 days live weevils were very numerous; so the house was resprayed with kerosene emulsion, 0.5 pound of DDT being used. On July 30 "nervous" and dead adults were numerous on the floor. Observations were repeated at intervals through September 8, and no live adults were found on August 25 or thereafter.

House C was approximately 2500 cubic feet in size and contained about 40 bushels of heavily infested sweetpotatoes and a dense population of adult weevils. The walls and floor were sprayed on July 26 with 10 gallons of kerosene emulsion containing 0.5 pound of DDT. On July 30 dead and affected weevils were numerous on the floor and walls, and emergence from the old potatoes was heavy. By August 17 the emergence was so heavy that the owner cleaned out the house and burned the infested potatoes, but many living adults remained in the house. Although many dead weevils were present up to this time, there were so many live specimens that it was hard to estimate the results of the treatment. On August 25 living weevils could not be found, and sweetpotatoes were provided as traps for any that may have been present. A single living adult was found on the traps on August 31. None were observed September 8 either on the traps or in the house.

House D, approximately 2500 cubic feet in size, contained a few bushels of sweetpotatoes and numerous adult weevils. The walls, floor, and sweetpotatoes were sprayed on August 4 with 25 gallons of kerosene emulsion containing 1 pound of DDT. One bushel of uninfested potatoes was sprayed and placed in the house as a trap for adults. The owner cleaned up the house and destroyed all old potatoes during the first week after treatment. Adult weevils could not be found 8 days after treatment, and no further observations were made.

On August 3, seven crates, each containing a bushel of sweetpotatoes heavily infested with weevils, were thoroughly dusted with 10-percent DDT mixture and stacked in a corner of a room. A similar untreated crate was placed in another room. Daily observations were made for 1 month. As weevils emerged they had to crawl over the treated potatoes and crates, thus coming in contact with the DDT. Weevils were active for a short time after emergence, but soon became "nervous" and died. A few weevils were found on their sides and kicking, several feet from the crates, but none of these recovered and none were observed to escape. A month after treatment dead adults were so numerous under and around the crates of potatoes that no attempt was made to count them, but it was estimated that between 3,000 and 4,000 adults were killed. All the potatoes in the treated crates were dissected, and no specimens remained in them. Emergence and activities of adults in the untreated crate were normal during the entire month.

On November 9, two crates of heavily infested sweetpotatoes and two uninfested crates were dusted with 10-percent DDT mixture and placed in the greenhouse for observation. The crates were set side by side, the infested alternated with the uninfested, so that the uninfested sweetpotatoes would have equal and close exposure to emerging weevils. The temperature was approximately 80° F., and emergence was heavy. On

December 17, 5 weeks after treatment, between 2,000 and 3,000 dead weevils were under and around the infested crates. There were also a number of live adults on their sides and wiggling their legs, and a few appeared normal. Emergence was not complete, as a few living pupae and adults were found within the sweetpotatoes.

The previously uninfested sweetpotatoes were also examined on December 17. No eggs could be found and only a few tubers had been fed upon, and these only to a slight extent. Some feeding was expected, since the adults move about for short distances after coming in contact with DDT before they die.

## Conclusion

Experiments in the laboratory and in storages with DDT in dust mixtures, emulsions, solutions, and spray suspensions showed that this material was very toxic to sweetpotato weevil adults crawling over surfaces treated with it. DDT in residual applications will greatly reduce the sweetpotato weevil populations in storage houses, banks, and on potatoes, particularly crop remnants and cull material, killing the weevils before they migrate to other potatoes or fields and before much oviposition occurs. DDT is poisonous to man and higher animals, however, and cannot be recommended at this time for use on sweetpotatoes that are to be marketed or consumed as food. The most practical formulations have not been determined, but satisfactory results were obtained with kerosene emulsion containing 0.24 to 0.5 percent of DDT and 5 to 10 percent of kerosene. In emulsions about 1 pound of DDT is applied per 3,000 to 4,000 cubic feet of storage space.

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